

## REMARKS

Claims 1, 2 and 4-15 are pending in this application.

The presently claimed invention is directed to a method of manufacturing a semiconductor device. All of the present claims require dry-etching an insulating film "by using the mask pattern as a mask and etching gas which contains  $C_4F_8$  gas and  $C_xF_y$  gas (wherein  $x$  and  $y$  are an integer and satisfy  $x \geq 5$  and  $y \leq (2x - 1)$ ; wherein the  $C_xF_y$  gas is  $C_5F_8$  gas and said dry-etching step is performed under a condition of  $0 < P_2/(P_1 + P_2) \leq 0.5$  where  $P_1$  is a partial pressure of the  $C_4F_8$  gas and  $P_2$  is a partial pressure of the  $C_5F_8$  gas."

The Office Action rejects claims 1, 2, 4 and 5 under 35 U.S.C. 103(a) as being unpatentable over Donohoe et al. (U.S. Patent No. 6,635,335) in view of Bhardwaj et al. (U.S. Patent No. 6,051,503). The Office Action also rejects claim 6 under 35 U.S.C. 103(a) as being unpatentable over Donohoe et al. in view of Bhardwaj et al. and further in view of Hung et al. (U.S. Patent No. 6,380,096). The Office Action also rejects claims 7, 8 and 10 under 35 U.S.C. 103(a) as being unpatentable over Hung et al. in view of Donohoe et al. The Office Action also rejects claim 9 under 35 U.S.C. 103(a) as being unpatentable over Hung et al. in view of Donohoe et al. and further in view of Bhardwaj et al. The Office Action also rejects claims 11, 12 and 14 were rejected under 35 U.S.C. 103(a) as being unpatentable over Hung et al. in view of Donohoe et al. The Office Action also rejects claim 13 were rejected under 35 U.S.C. 103(a) as being unpatentable over Hung et al. in view of Donohoe et al. and further in view of Bhardwaj et al. These rejections are traversed.

As the Office Action notes, "Hung and Donohoe fail to disclose the specific value of the fractional partial pressure of  $C_4F_8$  and  $C_5F_8$  gases is greater than 0 and less than or equal to 0.5" (page 8, section 7 of the Office Action). Thus, Donohoe et al. and Hung et al. fail to teach or suggest an "etching gas which contains  $C_4F_8$  gas and  $C_xF_y$  gas (wherein x and y are an integer and satisfy  $x \geq 5$  and  $y \leq (2x - 1)$ ; wherein the  $C_xF_y$  gas is  $C_5F_8$  gas and said dry-etching step is performed under a condition of  $0 < P_2/(P_1 + P_2) \leq 0.5$  where  $P_1$  is a partial pressure of the  $C_4F_8$  gas and  $P_2$  is a partial pressure of the  $C_5F_8$  gas" as required by the present claims.

Bhardwaj et al. discloses that "etching and deposition gases may be mixed" (column 1, lines 49-50). The "etch gas may particularly preferably be one or a combination of  $Cl_2$ ,  $BCl_3$ ,  $SiCl_4$ ,  $SiCl_2H_2$ ,  $CH_xCl_y$ ,  $C_xCl_y$ , or  $CH_x$  with or without H or an inert gas....[and the] deposition gas may be one or a combination of  $CH_x$ ,  $CH_xCl_y$  or  $C_xCl_y$  with or without H, or an inert gas  $CH_4$  or  $CH_2Cl_2$  are particularly preferred" (column 2, lines 45-52).

Bhardwaj et al. discloses that for "the residual partial pressure of gas A (Ppa) which can be tolerated in the partial pressure of gas B(Ppb)" the "minimum value of Ppa in Ppb is established from the characteristic process rate (etch or deposition) as a function of  $Ppa/(Ppa+Ppb)$ ." (column 6, lines 8-13).

Thus, where the Bhardwaj et al. refers to "where  $Ppa/(Ppa+Ppb)$ , 5%, the process is steady state," they are referring to a steady state process including steps of depositing with inert  $CH_4$  and separate steps of etching with  $SF_6$  (not a steady state of etching as asserted in the Office Action). Bhardwaj et al. nowhere teaches or suggests that Ppa and Ppb could both refer to etching gas. Thus, Bhardwaj et al. of course could not have taught or suggested an "etching gas which contains  $C_4F_8$  gas and  $C_xF_y$  gas

(wherein x and y are an integer and satisfy  $x \geq 5$  and  $y \leq (2x - 1)$ ; wherein the  $C_xF_y$  gas is  $C_5F_8$  gas and said dry-etching step is performed under a condition of  $0 < P_2/(P_1 + P_2) \leq 0.5$  where  $P_1$  is a partial pressure of the  $C_4F_8$  gas and  $P_2$  is a partial pressure of the  $C_5F_8$  gas" as required by the present claims.

Applicants respectfully submit that one of skill in the art would not have been expected or motivated to use the steady state depositing/etching process of Bhardwaj et al. with the straight etching processes of Donohoe et al. and Hung et al. Furthermore, even if the depositing/etching gases used in Bhardwaj et al. were used in Donohoe et al. and/or Hung et al., none of these references teach or suggest using etching gas which contains  $C_4F_8$  gas and  $C_xF_y$  gas (wherein x and y are an integer and satisfy  $x \geq 5$  and  $y \leq (2x - 1)$ ; wherein the  $C_xF_y$  gas is  $C_5F_8$  gas and said dry-etching step is performed under a condition of  $0 < P_2/(P_1 + P_2) \leq 0.5$  where  $P_1$  is a partial pressure of the  $C_4F_8$  gas and  $P_2$  is a partial pressure of the  $C_5F_8$  gas" as required by the present claims.

Furthermore, in Bhardwaj,  $P_{pa}$  is the partial pressure of the gas (A) in the preceding step, and  $P_{pb}$  is the partial pressure of the gas (B) to be used in the subsequent step (column 1, b lines 59-62). In contrast,  $P_1$  and  $P_2$  of the present invention are partial pressures of gases used in the same step. Bhardwaj's formula  $P_{pa}/(P_{pa}+P_{pb})$  appears to be similar to the formula  $P_2/(P_1+P_2)$  of the present invention, but parameters in Bhardwaj's formula are clearly different from parameters in the formula of the present invention.

The Examiner insists that Donohoe discloses the step of etching the dielectric layer 409 using mask pattern 407 as a mask and etching gas contains a mixture of  $C_4F_8$

and C<sub>5</sub>F<sub>8</sub> (col. 10, lines 1-4). However, Donohoe states that other suitable gases include halogenated hydrocarbons, including iodinated, chlorinated, and fluorinated hydrocarbons, including CF<sub>4</sub>, CHF<sub>3</sub>, CH<sub>3</sub>F, C<sub>2</sub>F<sub>6</sub>, C<sub>2</sub>HF<sub>5</sub>, C<sub>3</sub>F<sub>8</sub>, C<sub>4</sub>F<sub>8</sub>, C<sub>4</sub>F<sub>6</sub>m and C<sub>5</sub>F<sub>8</sub>, and mixtures of these gases (column 9, line 66 - column 10, line 2). At least one of the gases included in the mixture should be thought to include hydrogen because Donohoe states "hydrocarbon". Applicants thus respectfully submit that Donohoe does not disclose a mixture of two gases, both of which do not include hydrogen. In contrast, both of the gases of the present invention do not include hydrogen.

The Examiner confesses that Hung fails to disclose using an etching gas contains C<sub>4</sub>F<sub>8</sub> and C<sub>x</sub>F<sub>y</sub> gas (page 5, lines 15-17, and page 7, lines 13-15 of the Office Action). As explained in the above item 1), Donohoe does not disclose a mixture of two gases, both of which do not include hydrogen.

For at least the above reasons, reconsideration and withdrawal of the rejections under 35 U.S.C. § 103(a) are respectfully requested.

### **Conclusion**

Applicant respectfully submits that this application is in condition for allowance and such action is earnestly solicited. If the Examiner believes that anything further is desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact Applicant's undersigned representative at the telephone number listed below to schedule a personal or telephone interview to discuss any remaining issues.

Should this paper not be considered timely filed, Applicant petitions for an appropriate extension of time. Please charge any such extension of time or any other fee deficiency or credit any overpayment to Deposit Account No. 01-2300, making reference to Attorney Docket No. 107317-00040.

Respectfully submitted,

A handwritten signature in black ink, reading "Robert K. Carpenter", with a horizontal line drawn underneath it.

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Enclosure: Petition for Extension of Time